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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/658,711	09/08/2003	Avetik Harutyunyan	23085-08273	6981
45380	7590	07/30/2008	EXAMINER	
HONDA/FENWICK SILICON VALLEY CENTER 801 CALIFORNIA STREET MOUNTAIN VIEW, CA 94041				STOUFFER, KELLY M
ART UNIT		PAPER NUMBER		
1792				
MAIL DATE		DELIVERY MODE		
07/30/2008		PAPER		

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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/658,711  
Filing Date: September 08, 2003  
Appellant(s): HARUTYUNYAN, AVETIK

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Narinder S. Banait  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed 19 June 2008 appealing from the Office action mailed 21 August 2007.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct. It is noted that the sentence on page 2 of the Brief "The application contains a single independent method claim" clearly refers to claim 1 of the instant application.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

6,232,706	DAI et al.	05-2001
2002/0036452 A1	MUROYAMA et al.	03-2002
5,863,601	KIKUCHI et al.	01-1999
4,650,895	KADOKURA et al.	03-1987

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1, 3-15, and 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over US patent number 6232706 to Dai et al. in view of US Patent publication 2002/0036452 A1 to Muroyama et al

With regard to claims 1 and 11, Dai et al. includes a method for synthesizing carbon nanostructures including providing a substrate having a deposition mask (column 3 lines 57-59), depositing an Fe layer on a on an unmasked portion of the substrate, removing the mask (shadowmask 48 in Figure 3) oxidizing the Fe layer to form a growth catalyst then exposing the substrate to a carbon precursor gas at a deposition temperature to form carbon nanostructures (columns 3 and 4 lines 44-10).

Dai et al. does not include using an organometallic Fe layer instead of only Fe. Muroyama et al. discloses using a metalorganic layer (paragraph 0050 and examples 11 and 12) that may include a Fe metalorganic layer (paragraph 0098) as a catalyst layer for depositing carbon nanostructures deposited by PVD or CVD (paragraph 0097) to improve the carbon nanofilm/nanostructures grown in the property of selective growth (paragraph 0050).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Dai et al. to include metalorganic Fe instead of just Fe as taught by Muroyama et al. in order to improve the carbon nanofilm/nanostructures grown in the property of selective growth.

With regard to claim 3, Dai et al. discloses using a physical vapor deposition process to deposit iron (column 5 lines 44-47), which would deposit the metalorganic when combined with Muroyama et al.

With regard to claim 4, the thicknesses of the layers in Muroyama et al. depend upon the desired device characteristics. One of ordinary skill in the art would recognize that an electron emission device would have layers with thicknesses in the micron range. Additionally, it would have been obvious to one of ordinary skill in the art to modify the thickness of the metalorganic layer between 1-30 microns as claimed depending on the desired device characteristics absent evidence showing criticality for the claimed values.

Regarding claims 5-6, Muroyama et al. discloses the mask to be aluminum oxide in paragraphs 0096 and 0099.

Regarding claims 7 and 8 the substrate is composed of silicon oxide in Dai et al. column 3 lines 60-65.

Regarding claims 9 and 10 Dai et al. discloses the substrate annealed in an oxidizing atmosphere at 300 °C overnight (column 3 lines 59-60). One of ordinary skill in the art would recognize that if a shorter time was desired, the temperature should be increased, or if the temperature were decreased the annealing would take longer.

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Therefore these values are by routine experimentation and are not inventive. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Dai et al. to include annealing the iron in an oxidizing atmosphere from 2-4 hrs at 450-500 °C depending on the time and temperature requirements of the system absent evidence showing a criticality for the claimed values.

With regard to claims 12-14, Dai et al. discloses the exposure to carbon precursor gases 15-60 minutes in column 4 lines 2-4 and Muroyama et al. discloses using methane, hydrogen and argon to deposit carbon nanotubes to stabilize the gases and possible plasma discharge and deposit carbon nanotubes (paragraph 0103).

Regarding claim 15, Dai et al. discloses the deposition temperature of ethylene as a precursor gas at 700 °C (column 4 lines 1-3).

Regarding claim 17, Dai et al. uses the mask to pattern the substrate as shown in Figure 3, shadowmask 48. The mask is present during step B, the deposition of the organometallic material, and is not present during step C when the carbon is deposited. One of ordinary skill in the art would realize that removing the mask before or after the oxidation of the organometallic material would not make a difference in the procedure or Dai et al. as long as it was removed before the deposition of the carbon. Therefore, it would have been obvious to one of ordinary skill in the art to remove the mask before or after oxidation of the organometallic material in order to allow the carbon to be deposited.

Regarding claims 18 and 19, Dai et al. shows single walled 1D carbon nanotubes in Figure 3, reference number 28 and describes the nanotubes in columns 1 and 2 et seq.

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. in view of Muroyama et al. as applied above, and further in view of US patent number 5863601 to Kikuchi et al.

Dai et al. and Muroyama et al. include the limitations of claim 2 as discussed above except for using iron phthalocyanine as the metalorganic layer. Kikuchi et al. teaches using metalorganic material to be composed of Fe and phthalocyanine when forming carbon nanotubes in order to use a compound that will be useful in both CVD and PVD (column 2 lines 60-66).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Dai et al. and Muroyama et al. to include iron phthalocyanine as the metalorganic layer as taught by Kikuchi et al. in order to use a compound that will be useful in both CVD and PVD.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. in view of Muroyama et al. as applied above, and further in view of US Patent 4650895 to Kadokura et al. Dai et al. and Muroyama et al. include the provisions of claim 16 except purifying the organometallic compound before use. Kadokura et al. teaches purifying an organometallic compound before use with a procedure that could be used

with the method of Dai et al. and Muroyama et al. in order to remove impurities from the organometallic compound and prevent unwanted reaction products (column 1 lines 1-45).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Dai et al. and Muroyama et al. to include purifying the organometallic substance before use as taught by Kadokura et al. in order to remove impurities from the organometallic compound and prevent unwanted reaction products.

#### **(10) Response to Argument**

The applicant argues that the combination of Dai et al. (hereafter Dai) in view of Muroyama et al. (hereafter Muroyama) teaches away from each other and hence is not a proper *prima facie* case of obviousness because Dai includes a metal oxide as a catalyst where Muroyama teaches that a native oxide is undesirable and is removed from the catalyst layer. This argument is not found convincing.

Muroyama provides motivation for modifying the metal oxide catalyst of Dai to the metalorganic catalyst of Muroyama to improve the nanostructures' selective growth properties (Muroyama paragraph 0050). Though Muroyama teaches that removing native oxide is preferred when using the metalorganic catalyst in paragraph 0095, it by no means requires its removal, only prefers it for Muroyama's own device requirements. The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the

test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

In addition, though Muroyama may teach that removal of the *native oxide* (emphasis added) is a preferred embodiment in paragraph 0095, Muroyama goes on to teach in paragraph 0096 that a metal oxide (including those made from organometallic layers) may be used in the selective growth region for carbon nanostructures.

Muroyama is clearly distinguishing using a metal layer with a native metal oxide layer from using a purposely deposited metal oxide layer as a catalyst for carbon nanostructure deposition. One of ordinary skill in the art would not be surprised that a native oxide layer is undesirable, as this is usually a byproduct from an excess of oxygen in the deposition system and is uncontrolled surface growth (also viewed as a contaminant depending on the film's device application) with unknown thickness, composition, and catalytic activity. In fact, Muroyama teaches that the native oxide may be removed for more reliable growth of the carbon film in paragraph 0095. A metal oxide film to use as a catalyst, in contrast, is a layer that was purposely grown with a reasonably controlled composition, thickness and catalytic activity, resulting in reliably grown carbon nanostructures as discussed in Muroyama paragraph 0096.

Further, the examiner notes that the step of removing the oxide from the catalyst layer before depositing carbon nanostructures is not precluded from the claims. If Muroyama did teach that only a metal layer without metal oxide may be used as a catalyst and removal of the oxide layer is preferred (which it does not as discussed

above) the catalyst of Muroyama would still teach advantages over the catalyst of Dai to one of ordinary skill in the art.

The examiner notes that the arguments pertaining to claims 2 and 16 are refuted as discussed above in regard to the other claims.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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